HATCHERY EVALUATION REPORT

Carson NFH - Spring Chinook

February 1997

Integrated Hatchery Operations Team (IHOT)

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Carson NFH - Spring Chinook

An Independent Audit Based on Integrated Hatchery Operations Team (IHOT) Performance Measures

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Section 1

Executive Summary

This report presents the findings of the independent audit of the Carson NFH - Spring Chinook program. The hatchery is located 13 miles northwest of Carson in Skamania County, Washington. It lies in a heavily forested valley within the Gifford Pinchot National Forest at the confluence of Tyee Creek and Wind River. The hatchery is used for adult collection, incubation, and rearing of spring chinook.

The audit was conducted in 1996-1997 as part of a 2-year effort that will include 67 hatcheries and satellite facilities located on the Columbia and Snake River system in Idaho, Oregon, and Washington. The hatchery operating agencies include the U.S Fish and Wildlife Service, Idaho Department of Fish and Game, Oregon Department of Fish and Wildlife, and Washington Department of Fish and Wildlife.

Background

The audit is being conducted as a requirement of the Northwest Power Planning Council (NPPC) "Strategy for Salmon" and the Columbia River Basin Fish and Wildlife Program. Under the audit, the hatcheries are evaluated against policies and related performance measures developed by the Integrated Hatchery Operations Team (IHOT). IHOT is a multi-agency group established by the NPPC to direct the development of new basinwide standards for managing and operating fish hatcheries. The Bonneville Power Administration (BPA) contracted with Montgomery Watson to act as an independent contractor for the audit.

IHOT has established five basic policies that cover: (1) hatchery coordination, (2) hatchery performance standards, (3) fish health, (4) ecological interaction, and (5) genetics. The audit focuses on all these policies, with the exception of hatchery coordination. These policies are set forth in *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries (IHOT 1995).* That document is the source for the performance measures that are the basis of this audit.

The Audit Process

The audit was based on the facility management's response to a 109-page questionnaire. This audit form was completed through a five-step process in which:

- Information was obtained from headquarters.
- The hatchery manager was asked to fill out and return the audit form.
- A 1-2 day site audit visit was conducted to inspect facilities, review hatchery records, discuss audit form responses, and develop remedial action plans.
- A compliance report was developed to document the compliance status of each performance measure. This report was then shared with the hatchery manager and IHOT representative.

- This hatchery evaluation report was written to document compliance with IHOT performance measures and develop cost estimates for remedial actions when needed.

Carson NFH - Spring Chinook Results

The Carson NFH facility includes two ponds for adult holding, 46 concrete raceways, 2 rearing ponds, and incubation facilities. Carson NFH was placed into operation in 1938 to rear and release chinook salmon and trout. The hatchery was remodeled in 1956 under the Mitchell Act in an attempt to establish a spring chinook run in the Wind River. The goal of the hatchery is to restore and maintain upriver Columbia River spring chinook salmon stocks.

The Carson NFH - Spring Chinook program was in general compliance with most of the performance measures. In the area of program objectives, the hatchery was not meeting its adult return goal. The audit found that the hatchery was not in compliance with the screen approach criteria, water quality monitoring requirements, alarm requirements, and pathology-free water criteria, which are all facilities requirements. The hatchery exceeded its loading criteria for rearing and needs to develop specific incubation and rearing standards for the IHOT Operations Plan, smoltifcation goals, and a smoltification monitoring program. The hatchery did not have a Genetics Monitoring and Evaluation Program.

The specific areas in which the Carson NFH - Spring Chinook program requires remedial actions based on the IHOT performance measures are listed below. These remedial actions are listed in alphabetical order without intent of ranking or otherwise assigning priority:

- Design intake screens that meet IHOT screen criteria (Tyee Creek and Wind River)
- Develop alarm log
- Develop approved genetics M&E plan
- Develop smoltification goal and monitor
- Develop specific incubation and rearing standards for IHOT Operations Plan
- Improve fry-to-smolt survival
- Install flow alarm in incubation facility
- Modify rearing program to meet IHOT loading criteria for rearing
- Monitor TGP and record
- Provide disease-free water for incubation and early rearing
- Review IHOT temperature criteria for rearing
- Run analysis for missing water chemistry parameters and missing contaminant parameters
- Set up exchange training details between other hatcheries and agencies

Non-compliance issues resulting from items beyond human control or Performance Measures not relevant to this hatchery (Type 1 in Table 3, Section 4 of this report) were not listed above.

Section 2

Facility Description

Name:	Carson National Fish Hatchery
Stock/Species:	Spring Chinook
Operating Agency:	U.S. Fish and Wildlife Service
Funding Agency:	Mitchell Act
Location:	The hatchery is located 13 miles northwest of Carson in Skamania County, Washington. It lies in a heavily forested valley within the Gifford Pinchot National Forest at the confluence of Tyee Creek and Wind River.
Address:	14041 Wind River Highway Carson, WA 98610
Hatchery Manager:	Mr. Bruce M. McLeod
Phone: **Fax:**	(509) 427-5905 (509) 427-4238
Purpose:	Carson NFH was placed into operation in 1938 to rear and release chinook salmon and trout. The hatchery was remodeled in 1956 under the Mitchell Act in an attempt to establish a spring chinook run in the Wind River. The hatchery also provides spring chinook eggs for re-establishing spring chinook runs in some mid-Columbia River tributaries. The goal of the hatchery is to restore and maintain upriver Columbia River spring chinook salmon stocks.
Production Goal:	**Spring Chinook** Produce 1.42 million spring chinook smolts for on-station release. Produce 100,000 spring chinook smolts for off-station release. Provide 2 million spring chinook eggs to Big White Salmon Ponds and state agencies.
Water Supply:	Water rights total 42,639 gpm from three sources: Tyee Creek, Tyee Spring, and the Wind River. The main water source for the hatchery is Tyee Creek; the Wind River is used as a secondary supply.

Facilities:

Adult Holding:	2 concrete brood ponds - 23,360 cf each
Incubation:	24 troughs - 45 cf each
Early Rearing:	24 starter troughs - 105 cf each
Raceways:	46 concrete raceways - 1,280 cf each
Rearing Ponds:	2 dirt rearing ponds - 63,180 cf and 17,212 cf
Satellite Facilities:	None

Section 3

Compliance Status

The hatchery audits are based on compliance with written IHOT performance measures. These performance measures are documented in ***Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries*** (referred to as *IHOT 1995* in this report).[1] The purpose of the performance measures is to implement new basinwide policies that provide regional guidelines for operating anadromous hatcheries in the Columbia Basin.

The audit focuses on performance measures for IHOT policies that cover (1) hatchery performance standards, (2) fish health, (3) ecological interaction, and (4) genetics. These performance measures are intended to guide hatchery operations once production is established. For that reason, the hatchery operations audit included broodstock collection, spawning, incubation of eggs, fish rearing and feeding, fish release, equipment maintenance and operations, and personnel training. Production priorities are beyond the scope of this audit.

Based on *IHOT 1995*, a detailed 109-page audit form was developed. The audit form divided the performance measures into six major sections along major program and technical criteria areas. Two additional sections (sections 1 and 8) include general information and expenditure information needed for this Hatchery Evaluation Report and blank forms for additional comments. The following is the basic structure of the IHOT audit form:

Section 1	Performance Measures for General Information and Expenditure Information (PMs General 1-2)
Section 2	Performance Measures for Program Objectives (PMs 1-4)
Section 3	Performance Measures for Facility Requirements (PMs 5-15)
Section 4	Performance Measures for Hatchery Practices (PMs 16-25)
Section 5	Performance Measures for Fish Health Policy (PMs 26-34)
Section 6	Performance Measures for Ecological Interactions (PMs 35-38)
Section 7	Performance Measures for Genetics Policy (PMs 39-43)
Section 8	Blank Forms for Additional Comments.

Several performance measures are repeated in various sections of the audit form. These performance measures overlap in *IHOT 1995* and were retained to allow individuals interested in specific portions of the audit (such as Genetics or Fish Health) to determine the compliance status of all performance measures for a given topic in one location. A repeated performance measure is indicated by shaded text.

The Hatchery Audit Process

The hatchery audit will be conducted over a 2-year period that concludes in 1997. At each hatchery, a five-step process was used to complete the overall hatchery audit. This process

[1]Integrated Hatchery Operations Team (IHOT) 1995. *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries*, Bonneville Power Administration, Portland, Oregon.

consisted of research and onsite visits. The site visit at the Carson NFH was conducted on February 4, 1997.

The following is the five-step audit process:

1. Information was obtained from headquarters.

2. The hatchery manager was asked to fill out and return the **Audit Form**.

3. A 1-2 day site audit visit was conducted at each hatchery. During that visit an audit team inspected facilities, reviewed hatchery records, discussed audit form responses, and developed remedial action plans when appropriate.

4. During the site visit, the compliance status of each performance measure was discussed with the hatchery manager and IHOT representative. A portion of the Hatchery Evaluation Report was sent to the hatchery manager following the audit visit as a **Compliance Report**. That Compliance Report is Table 2 of this report.

5. Information from steps 1-4 was used to prepare a draft **Hatchery Evaluation Report**. This draft report was submitted to the operating agencies for review of the information used to determine compliance. Based on review and comments, a final Hatchery Evaluation Report was developed. The final report documents the compliance of a particular hatchery with the IHOT performance measures and presents cost estimates to correct any deficiencies.

Compliance Status of Carson NFH - Spring Chinook

The following table includes information on life-stages that are held on this facility for some portion of their rearing cycle (Table 1). For multi-facility programs, summary cost and contribution data is presented at the facility where rearing occurs. For the compliance status relating to performance measures that do not occur at this hatchery, please refer to the Hatchery Evaluation Reports for the hatcheries and stocks listed in Table 1. A check mark (✔) indicates that the specific life-stage is held at this facility.

This section documents the compliance status of the Carson NFH - Spring Chinook program. Each performance measure is presented in a table taken from the audit form (Table 2). The compliance status is identified by the following categories:

- **N/A** (not applicable)
- **Yes** (in compliance)
- **?** (unknown; generally due to unavailability of information to determine compliance)
- **No** (not in compliance).

Remedial actions are suggested for performance measures not in compliance. These remedial actions are grouped into categories and listed in Section 4 of this report, where the cost of the required remedial actions is also presented.

Table 1 Summary Program Information for Carson NFH - Spring Chinook

Component	Location of Adult Holding, Spawning, Incubation, and Rearing					
	Carson NFH	Big White Salmon Ponds				
Adult Collection	✔					
Adult Holding	✔					
Spawning	✔					
Fertilization	✔					
Incubation						
green-to-eyed	✔					
eyed-to-hatch	✔					
Rearing						
fry	✔	✔				
fingerlings	✔	✔				
smolts	✔	✔				
Acclimation/release	✔	✔				

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
the hatchery programs outlined in a subbasin nagement plan?		✔			Columbia Basin System Planning Production Plan and Mitchell Act	
ne hatchery operating under a current hatchery rational plan?		✔			IHOT Operations Plan and Carson NFH Internal Operations Plan	
s it understood by staff?		✔				
s it being followed?		✔				
hatchery monitoring and evaluation plan in place?					Hatchery Evaluation Action Plan	
Do you have a written monitoring and evaluation plan?		✔				
ult contribution to fisheries, spawning grounds, and chery		✔			Review of records	
ult pre-spawning survival as compared with blished goal		✔			Review of records; in compliance 3 out of last 3 years	
-take as compared with established hatchery goal				✔	Review of records; in compliance 2 out of last 4 years	Increase adult returns
en-egg to eyed-egg survival as compared with blished goal		✔			Review of records; in compliance 3 out of last 3 years	
d-egg to fry survival as compared with established l		✔			Review of records; in compliance 3 out of last 3 years	
to smolt survival as compared with established goal				✔	Review of records; in compliance 1 out of last 3 years	Improve fry-to-smolt survival through lower rearing density (See PM #19)
duction as compared with established goal				✔	Review of records; in compliance 2 out of last 3 years	Increase adult returns
cent survival (smolt to adult) as compared with blished goal				✔	Review of records; in compliance 1 out of last 3 years	Increase adult returns
nber of eggs, fry, fingerlings, smolts, and/or adults neet basinwide needs	✔				Review of records/Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
nperature						
Does your water temperature meet the criteria for spawning?		✔			Review of records/Discussion	
Does your water temperature meet the criteria for ncubation?		✔			Review of records/Discussion	
Does your water temperature meet the criteria for earing?				✔	Meet size goal; no problem	Review IHOT temperature criteria for rearing
solved gases						
s the oxygen level near saturation?		✔			Review of records/Discussion	
s the dissolved nitrogen level less than saturation?			✔		Review of records/Discussion	Monitor TGP and record
emistry						
mmonia (un-ionized)		✔			Review of records/Discussion	
Carbon Dioxide			✔		Incomplete data provided	Run analysis
Chlorine		✔			Review of records/Discussion	
H		✔			Review of records/Discussion	
Copper		✔			Review of records/Discussion	
Hydrogen Sulfide		✔			Review of records/Discussion	
ron		✔			Review of records/Discussion	
inc		✔			Review of records/Discussion	
bidity						
Does your turbidity meet the criteria?		✔			Review of records/Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
alinity and hardness						
Does your alkalinity and hardness meet the criteria?		✔			Review of records/Discussion	
rite						
Does your nitrite meet the criteria?		✔			Review of records/Discussion	
Contaminants						
ldrin		✔			Review of records/Discussion	
ndrin		✔			Review of records/Discussion	
Dieldrin		✔			Review of records/Discussion	
Heptachlor		✔			Review of records/Discussion	
Chlordane		✔			Review of records/Discussion	
Methoxychlor		✔			Review of records/Discussion	
indane			✔		No data	Run analysis
Malathion		✔			Review of records/Discussion	
Guthion			✔		No data	Run analysis
hogens						
What portions of the hatchery have disease-free water?						
Adult holding				✔	Inspection of facilities/Discussion	None
Incubation				✔	Inspection of facilities/Discussion	Provide disease-free water for incubation and early rearing
Early rearing				✔	Inspection of facilities/Discussion	See above
Rearing				✔	Inspection of facilities/Discussion	None
Others				✔	Inspection of facilities/Discussion	None

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
rm Systems						
)o the following areas have alarms?						
Intake		✔			Inspection of facilities/Discussion	
Large rearing ponds and adult holding ponds		✔			Inspection of facilities/Discussion	
Raceway headboxes and rearing ponds		✔			Inspection of facilities/Discussion	
Incubation facilities				✔	Inspection of facilities/Discussion	Install flow alarm in incubation facility
Quarantine areas and facilities	✔				No Quarantine areas and facilities	
Water treatment systems	✔				No Water treatment systems	
Security				✔	Inspection of facilities/Discussion	Install building security system
ıre there outside systems and buzzers in onsite esidences?		✔			Discussion	
ıre water flow alarms checked daily?		✔			Review of records/Discussion	
ıre all other alarms checked weekly?	✔				Only have flow alarms	
; there a log of alarms for emergencies, tests, and ıaintenance requirements?				✔	Review of records/Discussion	Develop alarm log
ıre telephone pagers used?		✔			Discussion	
ılt collection and holding facilities						
)o you meet the adult holding criteria?		✔			Review of records/Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
ıbation facilities						
'ype 1: Deep troughs)o you have an adequate number of units for the verall program?		✔			Inspection of facilities/Discussion	
'ype 2: Vertical Tray)o you have an adequate number of units for the verall program?		✔			Inspection of facilities/Discussion	
ıring facilities						
'ype 1: Raceways)o you have an adequate number of units for the verall program?		✔			Inspection of facilities/Discussion	
'ype 2: Earthen Pond (upper))o you have an adequate number of units for the verall program?		✔			Inspection of facilities/Discussion	
'ype 3: Earthen Pond (lower))o you have an adequate number of units for the verall program?		✔			Inspection of facilities/Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
eening facilities						
e Creek Intake						
)o you meet the approach velocity criteria?		✔			Inspection of facilities/Discussion	
ıre the fish screens regularly cleaned?		✔			Inspection of facilities/Discussion	
)oes the screen mesh meet screen opening criteria?				✔	Inspection of facilities/Discussion	Design intake screens that meet IHOT criteria
ıd River Intake						
)o you meet the approach velocity criteria?				✔	Inspection of facilities/Discussion	Design intake screens that meet IHOT criteria
ıre the fish screens regularly cleaned?				✔	Inspection of facilities/Discussion	See above
)oes the screen mesh meet screen opening criteria?				✔	Inspection of facilities/Discussion	
ıre rearing containers double screened for fish that hould not be released to adjacent water?	✔				Fish are released to Wind River	
dator control facilities						
ıre your predation control facilities effective?			✔		Covers for all facilities are scheduled for FY 97	None

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
d storage facilities and quality control						
)oes the storage of dry/semi-moist/moist foods dry<12%; semi-moist 12-20%; moist >20% moisture) ollow food manufacturer's recommendations?		✔			Inspection of facilities/Discussion	
)oes a regional quality control officer oversee roduction procedures and monitor:						
Verification by feed manufacturer that ingredients meet specifications?		✔			Discussion	
Ensure feed does not contain unwanted drugs or other additives?		✔			Discussion	
Analyze ingredients contained in the final food product to ensure that feed specifications have been met?		✔			Discussion	
ıre the foods stored and handled according to the ollowing criteria?						
Moist pellets should not exceed 10 °F at point of delivery.		✔			Discussion	
Moist pellets should be removed from freezer just prior to feeding.		✔			Discussion	
Do not leave buckets of feed or feed containers outside exposed to light or heat.		✔			Discussion	
Open bags of feed should be fed within 1 to 2 days except when feeding small groups of fish.		✔			Discussion	
Automatic feeder hoppers and bulk storage facilities should be insulated against excessive temperatures (80°F and above).	✔				No automatic feeders or bulk storage	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
ease facilities						
)o the release facilities ensure that fish are not ubjected to adverse conditions?		✔			Inspection of facilities/Discussion	
lution abatement facilities						
)o the pollution abatement facilities meet all federal nd state regulations (or good engineering practice)?		✔			Inspection of facilities/Discussion	
re pollution abatement facilities operated correctly?		✔			Discussion	
nsportation facilities						
re the transport systems adequate to meet IHOT erformance measures for transportation practices?	✔				No transport at hatchery	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
odstock selection practices						
s the donor selection process document attached? (PM 40a)	✔				Existing program; does not apply	
Was the donor selection outline followed in selecting ne hatchery broodstock? (PM #40b-c)	✔				Existing program; does not apply	
wning practices						
Were the appropriate number of spawners, male/female atios, and fertilization protocols used? (PM #42c-g)		✔			Review of records/Discussion	
ıbation practices						
specific incubation standards listed in the hatchery rations plan?		✔			Reviewed IHOT Operations Plan and Hatchery Operations Plan	Develop specific incubation standards for IHOT Operations Plan
incubation practices written?		✔			See above	
ıbation Type 1: Deep trough (see PM #8) you meet the loading and flow criteria?		✔			Review of records/Discussion	
ıbation Type 2: Vertical tray (see PM #8) you meet the loading and flow criteria?		✔			Review of records/Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
ring practices						
specific rearing standards listed in the hatchery rations plan?		✔			Review IHOT Hatchery Operations Plan and Hatchery Operations Plan	Develop specific rearing standards for IHOT Operations Plan
rearing practices written?		✔			Review Hatchery Operations Plan	
earing Unit Type 1: Raceways (see PM #9)						
Do you meet the density and DI criteria?		✔			Review of records/Discussion	
Do you meet the Loading and FI criteria?		✔			Review of records/Discussion	
earing Unit Type 2: Earthen Ponds (upper) (see PM 9)						
Do you meet the density and DI criteria?		✔			Review of records/Discussion	
Do you meet the Loading and FI criteria?		✔			Review of records/Discussion	
earing Unit Type 3: Earthen Ponds (lower) (see PM 9)						
Do you meet the density and DI criteria?		✔			Review of records/Discussion	
Do you meet the Loading and FI criteria?				✔	Review of records/Discussion	Modify rearing program to meet loading criteria for rearing
olt quality						
Do you produce a high quality smolt?		✔			Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
h health management practices						
re the monthly hatchery monitoring visits being onducted? (PM #26)		✔			Review of records/Discussion	
re the annual broodstock inspections being conducted? PM #27)		✔			Review of records/Discussion	
there pathogen-free water (PM #5h) and are the anitation procedures being followed? (PM #28)				✔	Review of records/Discussion	See PM #5h
re the following water quality parameters within riteria? (PM #5a-5g)						
Water temperature				✔	Review of records/Discussion	See PM #5a
Dissolved gases			✔		Review of records/Discussion	See PM #5b
Chemistry			✔		Review of records/Discussion	See PM #5c
Turbidity		✔			Review of records/Discussion	
Alkalinity and hardness		✔			Review of records/Discussion	
Nitrite		✔			Review of records/Discussion	
Contaminants			✔		Review of records/Discussion	See PM #5g
re rearing standards being followed? (PM #19)				✔	Review of records/Discussion	See PM #19
re egg and fish transfer/release requirements met? PM #31)		✔			Review of records/Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
s hatchery performance meet requirements lined in the regional hatchery policies and in basin and hatchery plans for the following areas?						
cent smoltification						
Do you measure percent smoltification?				✔	Discussion	Develop smoltification goal and monitor
Do you have a smoltification goal				✔	Discussion	See above
Did you meet the smoltification criteria?			✔		Discussion	See above
ring density (prior to release)						
Did you meet the rearing density criteria just prior to elease?				✔	Review of records/Discussion. Type 3 unit out of compliance.	See PM #19
ease condition (at release)						
Did you meet all disease regulations just prior to elease?		✔			Review of records/Discussion	
nber (at release)						
Did you meet the release number goal?				✔	Review of records/Discussion	Increase adult returns
at release						
Did you meet the size goal?		✔			Review of records/Discussion	
es of release						
Did you meet the release date goal?		✔			Review of records/Discussion	
ation of release						
Did you release the fish at the specified location?		✔			Review of records/Discussion	
fish reared in the subbasin or acclimated in the basin?						
are the fish reared in the subbasin?		✔			Discussion	
are the fish acclimated in the subbasin?		✔			Discussion	
he release strategy appropriate for the program?		✔			Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
nsportation facilities						
)o transportation equipment and personnel receive isinfection before and after use?	✔				No transportation of fish - done by other federal hatcheries.	
; the fish tank interior disinfected using a solution of 00 ppm active chlorine for 30 minutes minimum or ɔrmaldehyde gas generation method (relative humidity f 60% for 2 hrs)?	✔				See above	
Is the exterior of the fish transport vehicle disinfected using high pressure steam (115-130°C), high temperature acid, or with 200 ppm chlorine for 30 minutes?	✔				See above	
; the fish transport vehicle (cab) disinfected using 600 pm quaternary ammonia compounds (1.5 ml of 50% tock solution/liter water)?	✔				See above	
; other equipment disinfected including fish pumps, ets, egg sorters, waders, boots, rain gear, hoses and ther equipment using one of the following solutions?	✔				See above	
200 ppm chlorine for 30 minutes 600 ppm quaternary ammonia compound for 30 minutes 200 ppm iodophor solution for 10 minutes	✔					
)o personnel wear protective garments when handling sh eggs or cultural water?	✔				See above	
)o the fish transport truck/chassis and tank/unit receive n inspection and service prior to the release season?	✔				See above	
; a daily service inspection completed before starting p and leaving for the day?	✔				See above	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
nsportation facilities						
)oes the fish transport unit receive an inspection prior) loading?	✔				No transportation of fish	
)oes a pre-loading inspection covering tank water evel, pumps or aerators, oxygen injection system ettings, displacement gauge, and truck loading/hauling ensity tables checked and reviewed occur prior to)ading fish in the transport unit?	✔				See above	
)o hauling criteria include checking the fish 45 minutes) 1 hour after loading?	✔				See above	
Vhen fish are active and systems are functioning roperly, is the oxygen concentration reduced and ıaintained at approximately 8 ppm?	✔				See above	
; water temperature in the transportation unit ıaintained within the 42-48 °F range?	✔				See above	
)o fish releasing procedures include the following riteria?						
Releasing the fish at the correct release site or into the correct water body.	✔				See above	
Tempering or the difference between the liberation tank and the target water body should not exceed 10°F.	✔				See above	
The liberation hose should be angled so that fish gently hit the water. Using a tripod is a method of ensuring the hose will stay at the proper angle.	✔				See above	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
luation practices						
las the hatchery conducted fishery contribution studies):						
Determine the requirements for evaluating and improving management programs?		✔			Discussion	
Develop guidelines that define the geographical area and identify component stocks (hatchery and/or wild) that comprise the management unit?		✔			Discussion	
Develop guidelines that define if the proper stocks of fish are currently being used?		✔			Discussion	
Determine which management units contribute to a specific fishery and the time periods of those contributions?		✔			Discussion	
Determine the relative contributions of the various management units to a specific fishery over the different time periods?		✔			Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
ining practices						
Does the hatchery have a training schedule for its staff?		✔			Review of records/Discussion	
Does each staff member have a personal training plan approved by a supervisor and reviewed annually?		✔			Review of records/Discussion	
Does the hatchery routinely exchange training details between other hatcheries and agencies?				✔	Review of records/Discussion	Set up exchange training details between other hatcheries and agencies
Does the hatchery encourage and reward off-duty training of staff?		✔			Review of records/Discussion	
Does the hatchery conduct monthly staff meetings?		✔			Review of records/Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
monthly hatchery monitoring visits being ducted by a qualified fish health specialist as cribed below?						
Conduct visit at least monthly		✔			Review of records/Discussion	
Monitoring conducted by qualified fish health specialist		✔			Review of records/Discussion	
Examine a representative sample of healthy and moribund fish from each lot.		✔			Review of records/Discussion	
Review fish culture practices with hatchery manager.		✔			Review of records/Discussion	
Report finding and results of necropsies on standard form.		✔			Review of records/Discussion	
Recommend appropriate drug or chemical treatment.		✔			Review of records/Discussion	
Summarize fish health status or stock prior to release or transfer to another facility.		✔			Review of records/Discussion	
all of the functions of the hatchery yearly nitoring visits being completed as described below?						
Annually examine each broodstock for the presence of reportable viral pathogens.		✔			Review of records/Discussion	
Annually screen each salmon broodstock for the resence of *Renibacterium salmoninarum*.		✔			Review of records/Discussion	
Conduct inspection by or under the supervision of ualified fish health specialist.		✔			Review of records/Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
ıe hatchery following accepted sanitation cedures?						
ıre there any sources of pathogen-free water, especially ɔr incubation and early rearing?				✔	Discussion	Develop pathogen-free water for incubation and early rearing
ıre the hatchery sanitation procedures understood and eing followed as described below?						
Disinfect/water harden eggs in iodophor?		✔			Inspection of facilities/Discussion	
Are foot baths containing disinfectant placed at the incubation facility's entrance and exit?		✔			Inspection of facilities/Discussion	
Is equipment and rain gear utilized in broodstock handling or spawning sanitized prior to its use elsewhere in the hatchery?		✔			Inspection of facilities/Discussion	
Is equipment used to collect dead fish sanitized prior its use in another pond and/or lot of fish?		✔			Inspection of facilities/Discussion	
Is equipment, including vehicles used to transfer fish between facilities, disinfected prior to use with any other fish lots or at any other location?		✔			Inspection of facilities/Discussion	
Are rearing vessels sanitized after fish are removed and prior to introducing a new fish lot or stock?		✔			Inspection of facilities/Discussion	
Are dead fish properly disposed of?		✔			Inspection of facilities/Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
water quality parameters being followed?						
re the following water quality parameters within riteria? (PM #5a-5g)						
Water temperature				✔	Review of records/Discussion	See PM #5a
Dissolved gases			✔		Review of records/Discussion	See PM #5b
Chemistry			✔		Review of records/Discussion	See PM #5c
Turbidity		✔			Review of records/Discussion	See PM #5d
Alkalinity and hardness		✔			Review of records/Discussion	
Nitrite		✔			Review of records/Discussion	
Contaminants			✔		Review of records/Discussion	See PM #5g
o to PM #21						
incubation and rearing standards being followed?						
Are the incubation practices following the IHOT incubation criteria? (PM #18)		✔			Review of records/Discussion	
Are the rearing practices following the IHOT criteria? (PM #19)				✔	Review of records/Discussion	See PM #19
o to rearing practices PM #18-PM #19						
egg and fish transfer/release requirements met?		✔			Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
ne hatchery's program outlined in a subbasin nagement plan? Go to subbasin plan PM #1		✔			Columbia Basin System Planning Production Plan and Mitchell Act	
ne hatchery operating under a current hatchery rational plan? Go to operational plan PM #2		✔			IHOT Operations Plan and Carson NFH Internal Operations Plan	
hatchery monitoring and evaluation plan in place? Go to hatchery monitoring and evaluation plan PM #3		✔			Hatchery Evaluation Action Plan	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
s the hatchery program meet requirements blished in the regional hatchery policies and basin planning documents in the following areas: cies, stock, broodstock collection location, odstock numbers, broodstock collection strategy, spawning and egg-take protocols?						
Does the hatchery program meet the requirements for he following?						
Species protocols (PM #1)		✔			Review of records/Discussion	
Stock protocols (PM #1)		✔			Review of records/Discussion	
Broodstock collection location protocols (PM #41b for existing program; PM #39b for new program)		✔			Review of records/Discussion	
Broodstock numbers protocols (PM #42c)		✔			Review of records/Discussion	
Broodstock collection strategy protocols (PM #41b-d for existing program; PM 39b-f for new program)		✔			Review of records/Discussion	
Spawning protocols (PM #42d-e)		✔			Review of records/Discussion	
Egg-take protocols (PM #42f-g)		✔			Review of records/Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
s the hatchery's performance meet requirements						
ined in the regional hatchery policies and in basin and hatchery plans for the following areas: cent smoltification, rearing density, disease						
dition, and the number, size date(s), and location of ase?						
ercent smoltification (PM #22a1)			✔		Review of records/Discussion	See PM #22a1
earing density (PM #22a2)				✔	Review of records/Discussion	See PM #19
)isease condition (PM #22a3)		✔			Review of records/Discussion	
Number at release (PM #22a4)				✔	Review of records/Discussion	See PM #22a4
ize at release (PM #22a5)		✔			Review of records/Discussion	
)ate of release (PM #22a6)		✔			Review of records/Discussion	
ocation of release (PM #22a7)		✔			Review of records/Discussion	
fish reared in the subbasin or acclimated in the basin? PM #22b		✔			Discussion	
ne release strategy appropriate for the program? PM #22c		✔			Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
new programs, has a broodstock collection plan n developed?						
s the broodstock collection plan written?	✔				Existing Program; does not apply	
or a non-captive broodstock program:	✔				Existing Program; does not apply	
Was an unbiased, representative sample collected?						
Was the recommended number of broodstock collected?	✔				Existing Program; does not apply	
or a captive broodstock program:						
Were captive brood progeny excluded as donors for propagating the next generation of the captive broodstock program?	✔				Existing Program; does not apply	
Were full-sib crosses avoided?	✔				Existing Program; does not apply	
s the broodstock collection plan understood and being ollowed by staff?	✔				Existing Program; does not apply	
a new program, was the donor selection outline owed in selecting the hatchery broodstock?						
s a donor selection plan written?	✔				Existing Program; does not apply	
Was the donor selection outline followed in selecting ne broodstock?	✔				Existing Program; does not apply	
Was the target stock recommended in the donor election process actually used?	✔				Existing Program; does not apply	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
existing programs, were the broodstock collection cedures followed?						
s the broodstock collection plan written?		✔			Review broodstock collection plan	
Does the broodstock collection plan follow the uideline:						
Was an unbiased, representative sample collected?		✔			Discussion	
Was the recommended number of broodstock collected?		✔			Discussion	
Were the broodstock collection procedures in hatchery operation plan understood and followed?		✔			Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
s the appropriate number of spawners, male/female os, and fertilization protocols used?						
ıre the spawning protocols written?		✔			Review of spawning protocols	
ıre daily or weekly spawning logs available?		✔			Review of records	
Vas the appropriate number of spawners used?		✔			Discussion	
)id you attempt to spawn all collected broodstock and ındomize mating with respect to age class, and other ·aits?		✔			Discussion	
Vas the sex-ratio within the limits given in the erformance standards?		✔			Discussion	
Vere the fertilization protocols followed?		✔			Discussion	
: the hatchery needed to reduce the number of eggs etained, was this done by representative sampling of ach male/female cross?		✔			Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
ıere a genetics monitoring and evaluation program lace?						
; a genetics monitoring and evaluation program vailable?				✔	No	Develop approved genetics M&E plan
)oes the plan address the following elements listed in HOT:						
Does the program have elements needed to meet evaluation goals 1-4?				✔	Discussion	See above
Has a qualified geneticist reviewed and endorsed the program (goal 5)?				✔	Discussion	See above
Will the program collect the data and maintain the records needed to evaluate compliance on an ongoing basis (goal 5)?				✔	Discussion	See above
Is the program understood and followed by staff?				✔	Discussion	See above

Section 4

Remedial Actions

Based on the compliance status for each performance measure, remedial actions were developed. The required remedial actions are organized into five categories. The types of categories range across a spectrum from those actions that are beyond human control, to those that require a change in agency policy or procedures, to those that involve a significant capital cost to put in place. The following are the five types of remedial actions identified under phase 1 of the audit:

The Five Types of Remedial Actions

Type	Description
1	Non-compliance issues resulting from items beyond human control or Performance Measures not relevant for this hatchery
2	Remedial actions requiring changes in agency policies or procedures
3	Remedial actions requiring changes in monitoring coverage or interval
4	Remedial actions requiring significant capital expenditures
5	Remedial actions that may require significant capital expenditures but are not clearly definable at this time

Remedial Actions at Carson NFH - Spring Chinook

This section presents the corrective actions required to bring the Carson NFH - Spring Chinook program into compliance with IHOT performance measures. The remedial actions suggested here are just that, suggestions developed by the Montgomery Watson Audit Team. For some non-compliance areas, other remedial actions could be proposed. The required remedial actions are cross-referenced to each IHOT performance measure that was not in compliance. Where appropriate, the costs associated with the remedial actions are also presented (Table 3).

The cost estimates presented in this section are based on professional experience from similar projects. In most cases, only a lump-sum figure is presented, and detailed take-off lists have not been prepared. The cost estimates are essentially order of magnitude estimates (± 40%).

More importantly, the suggested remedial activities may also present several levels of action. Optional actions have been listed for several problems. These optional actions are desirable for either operational or safety considerations.

Table 3. Remedial Actions Required at Carson NFH - Spring Chinook

Remedial Action Required	Cost	PMs[1]
Type 1 - Non-compliance issues resulting from items beyond human control or Performance Measures not relevant for this hatchery		
Improve adult returns	----	4c, 4g, 4h, 22a4
Type 2 - Remedial actions requiring changes in agency policies or procedures		
Review IHOT temperature criteria for rearing	----	5a
Develop alarm log	----	6
Install building security system	----	6
Develop specific incubation and rearing standards for IHOT Operations Plan	----	18-19
Modify rearing program to meet IHOT loading criteria for rearing	----	19
Develop smoltification goal and monitor	----	22a1
Set up exchange training details between other hatcheries and agencies	----	
Develop approved genetics M&E plan	----	43
Type 3 - Remedial actions requiring changes in monitoring coverage or interval		
Monitor TGP and record	----	5b
Run analysis for missing water chemistry parameters and missing contaminant parameters	----	5c, 5g

[1] PMs are performance measures that were extracted from the IHOT 1995 report. The IHOT performance measures are listed in Table 2 (Section 3 of this report) in numerical order.

Remedial Action Required	Cost	PMs[1]
Type 4 - Remedial actions requiring significant capital expenditures		
Install flow alarm in incubation facility	$10,000	6
Design intake screens that meet IHOT screen criteria (Tyee Creek and Wind River)	$480,000	10
Type 5 - Remedial actions that may require significant capital expenditures but are not clearly definable at this time		
Improve fry-to-smolt survival	----	4f
Provide disease-free water for incubation and early rearing	----	5h, 28

[1] PMs are performance measures that were extracted from the IHOT 1995 report. The IHOT performance measures are listed in Table 2 (Section 3 of this report) in numerical order.

Section 5

Hatchery Contribution to Fisheries, Spawning Grounds, and Hatcheries

This section presents the audit findings for the Carson NFH - Spring Chinook program contribution of adult fish to fisheries, local fisheries, spawning grounds, and hatcheries. Data is reported by broodyear. A broodyear refers to the adult contribution from the eggs produced from a single group of spawning adults. For some species, this may include fish caught as 2-, 3-, 4-, 5-, and 6-year old fish. Because of the return distribution and data processing delays, the complete adult contribution for a given broodyear may not be available until 4 to 5 years after the fish have been released from the hatchery.

Table 4. Adult Contribution to Fisheries, Spawning Grounds, and Hatcheries: Carson NFH - Spring Chinook

Year	Fisheries[1] (Broodyear)	Spawning Grounds[1] (Broodyear)	Hatchery[1] (Broodyear)	Total Combined Contribution[2] (Broodyear)	Smolt to Adult Survival (percent)
1981					
1982					
1983					
1984					
1985					
1986					
1987					
1988	6326	465	1628	8419	0.40
1989	2884	68	129	3081	0.13
1990	45	0	654	699	0.0002
1991					
1992					

[1] Data obtained from Missing Production Groups Annual Report or from the Regional Mark Information System database.

[2] Total combined adult contribution; presented when it is not possible to subdivide the contribution into fisheries, spawning grounds, and hatchery contributions.

Section 6

Annual Operating Expenditures

The level and detail of annual operating expenditures varies widely depending on hatchery, operating agency, and funding source. When provided, expenditures were presented in terms of personnel costs, operating costs (power, feed, supplies), capital costs, indirect costs charged to the federal government, third-party costs, and other costs. These cost components were summed to determine a total hatchery annual cost. Based on discussion with the hatchery manager, the percent of total hatchery costs allocated to a given program was estimated. The total hatchery costs and the percent of hatchery costs allocated to a given program were used to compute the cost of a given program. Table 5 shows the annual operating expenses for the Carson NFH - Spring Chinook program. For programs that occur at more than one facility (as shown on Table 1 in Section 3 of this report), the cost breakdown for the component(s) at each facility is presented in separate tables (Table 5a).

Table 5. Annual Operating Expenses: Carson NFH - Spring Chinook

Hatchery	1994	1995	1996
1. Carson NFH	**$612,635**	**$697,721**	**$478,290**
2.			
3.			
4.			
5.			
Total Program Costs	**$612,635**	**$697,721**	**$478,290**

The total expenditures for the Carson NFH are presented in Table 6 by program. The detailed breakdown of program expenditures at this hatchery are presented in separate tables (Table 6a).

Table 6. Annual Operating Expenses - Carson NFH

Program	1994	1995	1996
1. Spring Chinook	**$612,635**	**$697,721**	**$478,290**
2.			
3.			
4.			
5.			
Total Hatchery Costs	**$612,635**	**$697,721**	**$478,290**

Table 5a. Annual Operating Expenses: Carson NFH - Spring Chinook

Expenditure Occurring at Carson NFH

Component	1994	1995	1996
Personnel Costs	$265,852	$261,233	$230,582
Operational Costs[1]	$156,821	$153,103	$171,051
Capital Costs	$189,962	$283,385	$76,657
Indirect Costs			
Lumped Hatchery Costs[2]			
Lumped Third-Party Costs			
Total Hatchery Costs	**$612,635**	**$697,721**	**$478,290**
Source of Funds			
NMFS	**100%**	**100%**	**100%**
Program Production (lb)			
Total Production (lb)			
Program as Percent of Total	100%	100%	100%
Program Costs	**$612,635**	**$697,721**	**$478,290**

[1] Includes cyclical maintenance contract projects estimated to be equal to $20,000/year.
[2] When it was not possible to obtain a detailed cost breakdown from an agency or third party, the undivided costs were entered here.

Table 6a. Detailed Expenditures at Carson NFH by Program

Spring Chinook

Component	1994	1995	1996
Personnel Costs	$265,852	$261,233	$230,582
Operational Costs[1]	$156,821	$153,103	$171,051
Capital Costs	$189,962	$283,385	$76,657
Indirect Costs			
Lumped Hatchery Costs[2]			
Lumped Third-Party Costs			
Total Hatchery Costs	**$612,635**	**$697,721**	**$478,290**
Source of Funds			
NMFS	**100%**	**100%**	**100%**
Program Production (lb)			
Total Production (lb)			
Program as Percent of Total	100%	100%	100%
Program Costs	**$612,635**	**$697,721**	**$478,290**

[1] Includes cyclical maintenance contract projects estimated to be equal to $20,000/year.
[2] When it was not possible to obtain a detailed cost breakdown from an agency or third party, the undivided costs were entered here.